

## APPENDIX 10

### STRATIFIED SAMPLE DESIGN TO ESTIMATE HAWAII SEAT BELT USE RATES

**Stratified Sample Estimation of Hawaii Seat Belt Use Rates.** A model borrowed from Cochran (1977) and Kish (1965) was used to design stratified sample estimates. The primary stratum used was by island (county). The reason for this is that enforcement and other policies regarding restraint use are implemented at the county level. Additionally, due to cost limitations, the survey was limited to only the four most populated islands. The sampling unit in this study was defined in terms of the total number of registered vehicles in each county. Table 10.1 provides the total units, the number selected, and the respective probabilities of selection:

**TABLE 10.1**  
**MEASUREMENT OF SIZE AND SELECTION PROBABILITIES, 2002**

County	Registered Autos	Sample Size ( $n_h$ )	Probability of Selection
Oahu	614,985	30,127	.049
Maui	132,636	8,012	.061
Hawaii	132,305	7,389	.060
Kauai	61,316	5,260	.086

Because the measured variable in each application is a rate or proportion, the strata samples must be re-weighted to produce unbiased estimates of population proportion and variance.

The unbiased estimator of the population proportion,  $p$ , is

$$p = \sum_{h=1}^H W_h p_h$$

where the county stratum weight is

$$W_h = \frac{\text{county registration}}{\text{State registration}}$$

and where  $n_h$  is the stratum size and  $p_h$  is the proportion of belt users in the stratum,

$$\text{Var}(p) = \frac{1-f}{n} \sum_{h=1}^H W_h \frac{n_h - p_h}{n_h - 1} (1 - p_h)$$

The sampling fraction  $f$ , is approximately  $50,788/941,242 \approx .05$ , and

$$n = \sum_{h=1}^H n_h$$

**Sampling Weights.** Weights for the counties and the weighted state proportion of seatbelt users are given in Table 10.2. A complete table is provided in Appendix 9 of this report.

**TABLE 10.2**  
**STRATUM WEIGHTS AND STATE ESTIMATES COMPUTATIONAL FORMAT, 2002**

County	Stratum Weight	Stratum p	Contribution to State p [wt*p(usage)]	Sample size ( $n_h$ )	Stratum Variance Component [(p)(1-p)]/ $n_h/(n_h-1)$	Contribution to State Variance
Honolulu	0.633696	0.8363	0.5300	30,127	0.1369	0.0868
Maui	0.138710	0.7763	0.1077	8,012	0.1737	0.0241
Hawaii	0.151894	0.8643	0.1313	7,389	0.1173	0.0178
Kauai	0.075701	0.8766	0.0664	5,260	0.1082	0.0082
State Total			0.8354	50,788		
Overall Sampling Fraction =	0.005957				State Variance	0.0000026786
$f/n =$	1.95724E-05				Standard Deviation	0.001636643
Total Sample (N) = Confidence Interval =	50,788 $\pm 0.32\%$				Confidence Interval	0.003207821

The overall weighted state proportion is 0.8354. Each county contributes stratum variance between 0.1082 and 0.1737 and the variance of the proportion estimated from the total state sample is less than  $2.68 \times 10^{-6}$ . This methodology was reviewed by the Chief of Sampling Designs, National Center for Statistical Analysis, U.S. Department of Transportation.